

Unit
10

Acids, Bases and Salts

Long Answer Questions

Q.1 Define an acid and base according to Arrhenius concept with the help of examples.

Ans. Arrhenius Acid

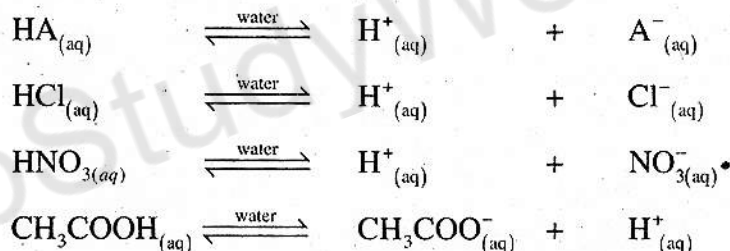
According to Arrhenius concept (1787)

Acid is a substance which dissociates in aqueous solution to give hydrogen ions (H^+).

Examples:

HCl, HNO_3 , CH_3COOH , H_2SO_4 , H_3PO_4 , HCN etc are acids because they ionize in aqueous solution to provide H^+ ions.

In general the ionization of acids takes place as follows:



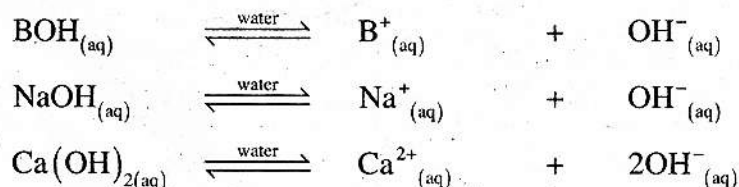
Arrhenius Base

Base is a substance which dissociates in aqueous solution to give hydroxide ions (OH^-).

Examples:

The substances such as NaOH, KOH, NH_4OH , $Ca(OH)_2$ etc are bases because they provide OH^- ions in aqueous solution.

In general the ionization of bases take place as follows:



Neutralization reactions according to Arrhenius concept

Acids give H^+ ions in water, bases give OH^- ions in water.

Q.2 Write down limitations of Arrhenius Concept.

Ans. Limitations of Arrhenius concept

- This concept is applicable only in aqueous medium and does not explain nature of acids and bases in non-aqueous medium.
- According to this concept, acids and bases are only those compounds which contain hydrogen (H^+) and hydroxyl (OH^-) ions, respectively. It can not explain the nature of compounds like CO_2 , NH_3 etc., which are acid and base, respectively.

Although this concept has limited scope yet, it led to the development of more general theories of acid-base behaviour.

Q.3 Describe Bronsted-Lowry concept about acids and bases with examples.

Ans. In 1923, the Danish chemist Bronsted and the English chemist Lowry independently presented their theories of acids and bases on the basis of proton transfer. According to this concept.

Bronsted-Lowry Acid

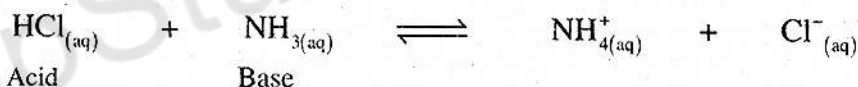
An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance e.g HCl .

Bronsted-Lowry Base

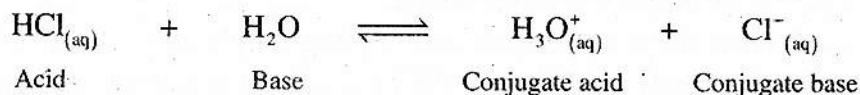
A base is a substance that can accept a proton (H^+) from another substance e.g NH_3 .

Explanation

HCl acts as an acid while NH_3 acts as base:



Similarly, when HCl dissolved in water; HCl acts as an acid and H_2O as a base.



It is a reversible reaction. In the forward reaction HCl is an acid as it donates a proton, whereas H_2O is a base as it accepts a proton. In the reverse reaction Cl^- ion is a base as it accepts a proton from acid H_3O^+ ion. Cl^- ion is called a conjugate base of acid HCl and H_3O^+ ion is called a conjugate acid of base H_2O . It means every acid produces a conjugate base and every base produces a conjugate acid such that there is conjugate acid-base pair. Conjugate means joined together as a pair.

Conjugate Acid

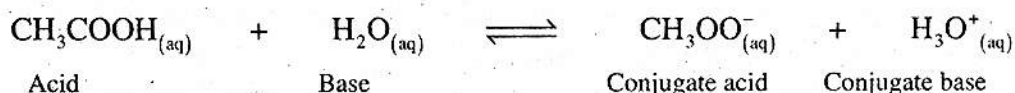
A conjugate acid is a specie formed by accepting a proton by a base.

Conjugate Base

A conjugate base is a specie formed by donating a proton by an acid.

Thus, conjugate acid-base pair differs from one another only by a single proton.

Similarly,



Limitations of Bronsted-Lowry concept

It has been observed that there are certain substances which behave as acids though they do not have the ability to donate a proton, e.g., SO_3 . Similarly, CaO behaves as a base but it cannot accept a proton. These observations prove the limitations of Bronsted-Lowry concept of acids and bases.

Conjugate acid-base pairs of common species.

Acid		Base		Conjugate acid		Conjugate base
$\text{HNO}_{3(\text{aq})}$	+	$\text{H}_2\text{O}_{(\text{l})}$	\rightleftharpoons	$\text{H}_3\text{O}^+_{(\text{aq})}$	+	$\text{NO}_{3(\text{aq})}^-$
$\text{H}_2\text{SO}_{4(\text{aq})}$	+	$\text{H}_2\text{O}_{(\text{l})}$	\rightleftharpoons	$\text{H}_3\text{O}^+_{(\text{aq})}$	+	$\text{HSO}_{4(\text{aq})}^-$
$\text{HCN}_{(\text{aq})}$	+	$\text{H}_2\text{O}_{(\text{l})}$	\rightleftharpoons	$\text{H}_3\text{O}^+_{(\text{aq})}$	+	$\text{CN}_{(\text{aq})}^-$
$\text{CH}_3\text{COOH}_{(\text{aq})}$	+	$\text{H}_2\text{O}_{(\text{l})}$	\rightleftharpoons	$\text{H}_3\text{O}^+_{(\text{aq})}$	+	$\text{CH}_3\text{COO}^-_{(\text{aq})}$
$\text{H}_2\text{O}_{(\text{l})}$	+	$\text{NH}_{3(\text{aq})}$	\rightleftharpoons	$\text{NH}_4^+_{(\text{aq})}$	+	$\text{OH}^-_{(\text{aq})}$
$\text{H}_2\text{O}_{(\text{l})}$	+	CO_3^{2-}	\rightleftharpoons	$\text{HCO}_3^-_{(\text{aq})}$	+	$\text{OH}^-_{(\text{aq})}$
$\text{HCl}_{(\text{l})}$	+	HCO_3^-	\rightleftharpoons	$\text{H}_2\text{CO}_{3(\text{aq})}$	+	$\text{Cl}^-_{(\text{aq})}$

Q.4 Define an acid and a base according to Bronsted-Lowry concept and justify with examples that water is an amphoteric compound.

Ans. In 1923, the Danish chemist Bronsted and the English chemist Lowry independently presented their theories of acids and bases on the basis of proton transfer. According to this concept.

Bronsted-Lowry Acid

An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance e.g HCl .

Bronsted-Lowry Base

A base is a substance that can accept a proton (H^+) from another substance e.g NH_3 .

Water as an amphoteric compound

According to Bronsted-Lowry concept, an acid and a base always work together to transfer a proton. That means, a substance can act as an acid (proton donor) only when another substance simultaneously behaves as a base (proton acceptor). Hence, a substance can act as

an acid as well as a base, depending upon the nature of the other substance. For example, H_2O acts as a base when it reacts with HCl and as an acid when it reacts with ammonia such as

Water acting as an acid:



Water acting as a base:



Amphoteric

Such a substance that can behave as an acid, as well as, a base is called **amphoteric**.

Q.5 Explain Lewis Concept of Acids and Bases with example.

Ans. The Arrhenius and Bronsted-Lowry concepts of acids and bases are limited to substances which contain protons. G.N. Lewis (1923) proposed a more general and broader concept of acids and bases. According to this concept.

Lewis Acid

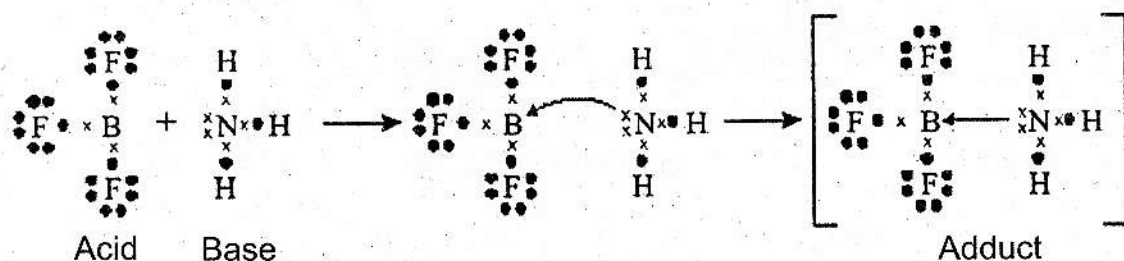
An acid is a substance (molecule or ion) which can accept a pair of electrons.

Lewis Base

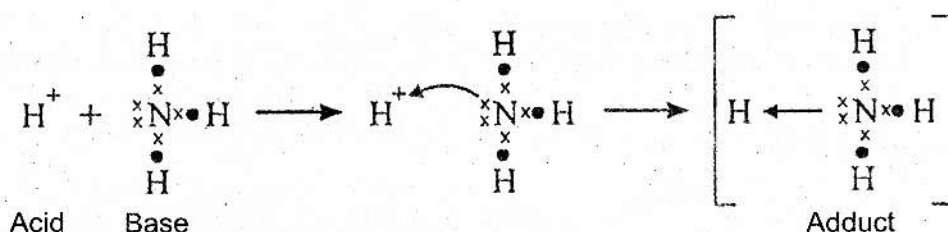
A base is a substance (molecule or ion) which can donate a pair of electrons.

Explanation

A reaction between ammonia and boron trifluoride takes place by forming a coordinate covalent bond between ammonia and boron trifluoride by donating an electron pair of ammonia and accepting that electron pair by boron trifluoride.



The cations (proton itself or metal ions) act as Lewis acids. For example a reaction between H^+ and NH_3 , where H^+ acts as an acid and ammonia as a base.



Adduct

The product of any Lewis acid-base reaction is a single specie, called an adduct.

Neutralization

A neutralization reaction according to Lewis concept is donation and acceptance of an electron pair to form a coordinate covalent bond in an adduct.

Conclusion

Acids are electron pair acceptors while bases are electron pair donors. Thus, it is evident that any substance which has an unshared pair of electrons can act as a Lewis base while a substance which has an empty orbital that can accommodate a pair of electrons acts as Lewis acid.

Q.6 Describe characteristics of Lewis Acids and Bases.

Ans. Characteristics of Lewis Acids:-

According to Lewis concept, the following species can act as Lewis acids.

- Molecules in which the central atom has incomplete octet. For example, in BF_3 , FeCl_3 , AlCl_3 , the central atom has only six electrons around it, therefore, these can accept an electron pair.
- Simple cations can act as Lewis acids. All cations act as Lewis acids since they are deficient in electrons. However, cations such as Na^+ , K^+ , Ca^{2+} ions, etc., have a very little tendency to accept electrons. While the cations like H^+ , Ag^+ ions, etc., have a greater electron accepting tendency therefore, act as Lewis acids.

Characteristics of Lewis Bases

According to Lewis concept, the following species can act as Lewis bases:

- Neutral species having at least one lone pair of electrons. For example, ammonia, amines, alcohols etc., act as Lewis bases because they contain a lone pair of electrons:



- Negatively charged species or anions. For example, chloride, cyanide, hydroxide ions, etc., act as Lewis bases:

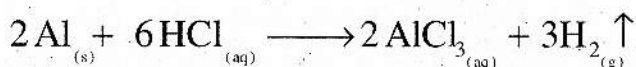
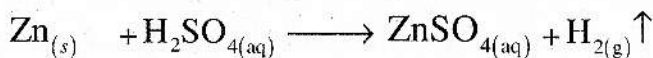


Q.7 Explain the chemical properties of acids.

Ans (i) Reaction with metals

Acids react explosively with metals like sodium, potassium and calcium. However dilute acids (HCl, H₂SO₄) react moderately with reactive metals like:

Mg, Zn, Fe and Al to form their respective salts with the evolution of hydrogen gas.



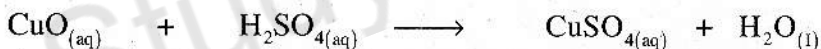
(ii) Reaction with Carbonates and Bicarbonates

Acids react with carbonates and bicarbonates to form corresponding salts with the evolution of carbon dioxide gas.



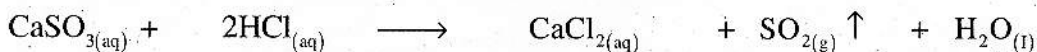
(iii) Reaction with bases

Acids react with bases (oxides and hydroxides of metal and ammonium hydroxide) to form salts and water. This process is called neutralization.



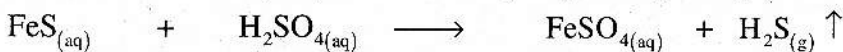
(iv) Reaction with Sulphites and Bisulphites

Acids react with sulphites and bisulphites to form salts with liberation of sulphur dioxide gas.



(v) Reaction with Sulphides

Acids react with metal sulphides to liberate hydrogen sulphide gas.



Q.8 Write down the uses of Acids

Ans Uses of Acids

- (i) **Sulphuric acid** is used for manufacture of fertilizers, ammonium sulphate, calcium superphosphate, explosives, paints, dyes, drugs it is also used as an electrolyte in lead storage batteries, and other chemicals.

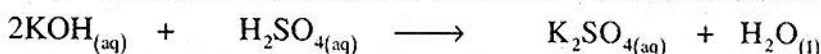
- (ii) **Nitric acid** is used for manufacturing of fertilizer (Ammonium nitrate), explosives, paints and drugs. Etching designs on copper plates.
- (iii) **Hydrochloric acid** is used for cleaning metals, tanning and in printing industries.
- (iv) **Benzoic acid** is used for food preservation.
- (v) **Acetic acid** is used for flavouring food and food preservation. It is also used to cure the sting of wasps.

Q.9 Explain chemical properties of bases.

Ans. **Chemical Properties of Bases**

(i) Reaction with acids

Bases react with acids to form salt and water. It is a neutralization reaction.



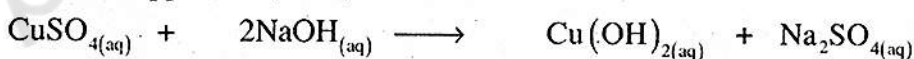
(ii) Reaction with Ammonium Salts

Alkalis react with ammonium salts to liberate ammonia gas.

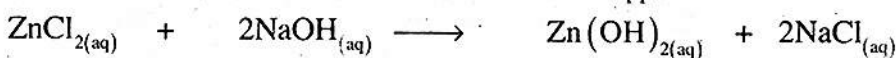


(iii) Precipitation of Hydroxides

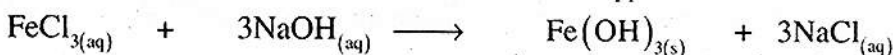
Alkalis precipitate insoluble hydroxides when added to solutions of salts of heavy metals such as copper, iron, zinc, lead and calcium.



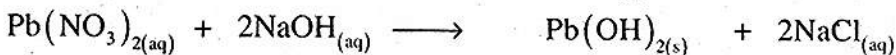
Blue ppt.



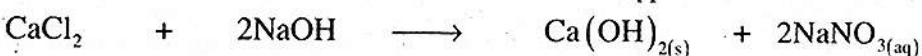
White ppt.



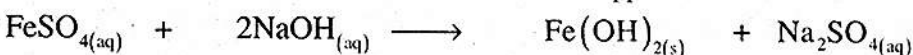
Brown ppt.



White ppt.



White ppt.



Dirty Green.

Q.10 Write down the uses of bases.

Ans. Uses of Bases

- (i) **Sodium hydroxide** is used for manufacturing of soap, artificial silk, in textile and paper industries and as a laboratory reagent.
- (ii) **Calcium hydroxide** is used for manufacturing of bleaching powder, softening of hard water and neutralizing acidic soil and lakes due to the acid rain.
- (iii) **Potassium hydroxide** is used in alkaline batteries and shaving cream.
- (iv) **Magnesium hydroxide** is used as a base to neutralize acidity in the stomach. It is also used for the treatment of bee's stings.
- (v) **Aluminium hydroxide** is used as foaming agent in fire extinguishers.
- (vi) **Ammonium hydroxide** is used to remove grease stains from clothes.

Q.11 What is auto-ionization of water? How it is used to establish the pH of water.

Ans. Concentration of hydrogen ion $[H^+]$ in pure water is the basis for the pH scale. Water is a weak electrolyte because it ionizes very slightly into ions in a process called auto ionization or self ionization;



The equilibrium expression of this reaction may be written as

$$K_c = \frac{[H^+][OH^-]}{[H_2O]}$$

As concentration of water (H_2O) is almost constant. The above equation may be written as

$$K_c [H_2O] = [H^+][OH^-]$$

A new equilibrium constant known as ionic product constant of water ' K_w ' is used instead of product of equilibrium constant and $[H_2O]$. Therefore,

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

As we know, one molecule of water produces one H^+ ion and one OH^- ion on dissociation. So

$$[H^+] = [OH^-] \quad \text{or} \quad [H^+]^2 = 1.0 \times 10^{-14}$$

$$[H^+] = \sqrt{1.0 \times 10^{-14}}$$

Therefore, $[H^+] = 1.0 \times 10^{-7} \text{ M at } 25^\circ\text{C}$

As it is difficult to deal with such small figures having negative exponents, so it is convenient to convert these figures into a positive figure using a numerical system. It is taking the common (base-10) logarithm of the figure and multiplying it with -1. 'p' before

the symbol H means 'negative logarithm of H^+ '. On this scale pH is the negative logarithm of molar concentration of the hydrogen ions. That is,

$$pH = -\log [H^+]$$

So, according to this scale, pH of water is:

$$pH = -\log (1.0 \times 10^{-7}) = 7$$

Similarly $pOH = -\log (1.0 \times 10^{-7}) = 7$

$$pOH = -\log [OH^-]$$

pH value normally varies from 0 to 14. therefore;

$$pH + pOH = 14$$

So, the sum of the pH and pOH of the solution is always 14 at 25°C .

Identification of acids and bases by pH scale

	Highly acid				Slightly acid			Neutral		Slightly basic			Highly basic		
pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
pOH	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

A solution or compound of pH 7 or pOH 7 is considered a neutral solution. Solutions of pH less than 7 are acidic and more than 7 are basic as are also shown in fig.

	$[H_3O^+]$	pH	$[OH^-]$	pOH
BASIC	1×10^{-14}	14.0	1×10^{-0}	0.0
	1×10^{-13}	13.0	1×10^{-1}	1.0
	1×10^{-12}	12.0	1×10^{-2}	2.0
	1×10^{-11}	11.0	1×10^{-3}	3.0
	1×10^{-10}	10.0	1×10^{-4}	4.0
	1×10^{-9}	9.0	1×10^{-5}	5.0
	1×10^{-8}	8.0	1×10^{-6}	6.0
NEUTRAL	1×10^{-7}	7.0	1×10^{-7}	7.0
ACIDIC	1×10^{-6}	6.0	1×10^{-8}	8.0
	1×10^{-5}	5.0	1×10^{-9}	9.0
	1×10^{-4}	4.0	1×10^{-10}	10.0
	1×10^{-3}	3.0	1×10^{-11}	11.0
	1×10^{-2}	2.0	1×10^{-12}	12.0
	1×10^{-1}	1.0	1×10^{-13}	13.0
	1×10^{-0}	0.0	1×10^{-14}	14.0

Since the pH scale is logarithmic, a solution of pH 1 has 10 times higher concentration of $[H^+]$ than that of a solution of pH 2, 100 times than that of a solution of pH 3 and so on.

Hence, low pH value means strong acid while high pH value means a strong base and vice versa.

Conclusion

- (i) pH of a neutral solution is always 7.
- (ii) Acidic solution has pH less than 7
- (iii) Basic solution has pH value greater than 7
- (iv) pH and pOH values range from 0 to 14.

Q.12 Write an note on the followings

- (i) Indicators
- (ii) Universal indicators
- (iii) pH meter

Ans. Indicators

Indicators are the organic compounds. they have different colours in acidic and alkaline solutions. Litmus is a common indicator. It is red in acidic solutions and blue in alkaline solutions.

- Each indicator has a specific colour in acidic medium which changes at a specific pH to another colour in basic medium. For example, phenolphthalein is colourless in strongly acidic solution and red in strongly alkaline solution. It changes colour at a pH of about 9. This means phenolphthalein is colourless in a solution with pH less than 9. If the pH is above 9, phenolphthalein is red as is shown in figure.

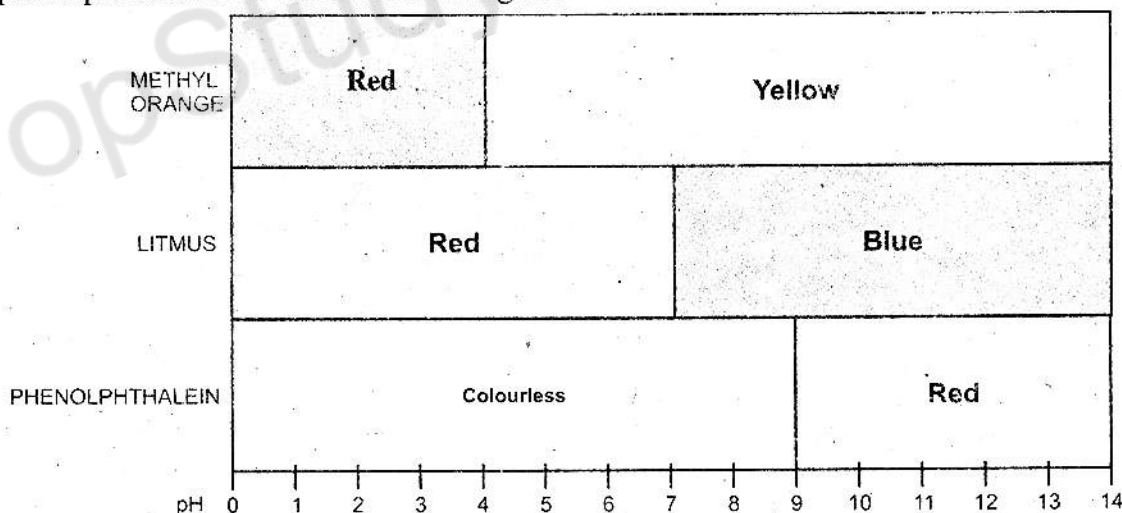


Fig: Colours of indicators at different pH solutions

A few commonly used indicators in titrations are given in Table:

Table : Few important indicators

Indicator	Colour in strongly acidic solution	pH at which colour changes	Colour in strongly alkaline solution
Methyl orange	red	4	yellow
Litmus	red	7	blue
Phenolphthalein	colourless	9	red

(i) Universal Indicator

Some indicators are used as mixtures. The mixture indicators give different colours at different pH values. Hence, it is used to measure the pH of a solution. Such a mixed indicator is called Universal Indicator or simply pH indicator. The pH of solution can be measured by dipping a piece of Universal Indicator paper in the solution. The pH is then found by comparing the colour obtained with a colour chart as shown in figure.

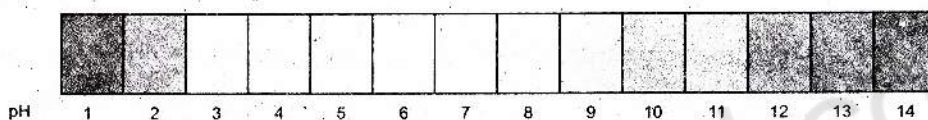
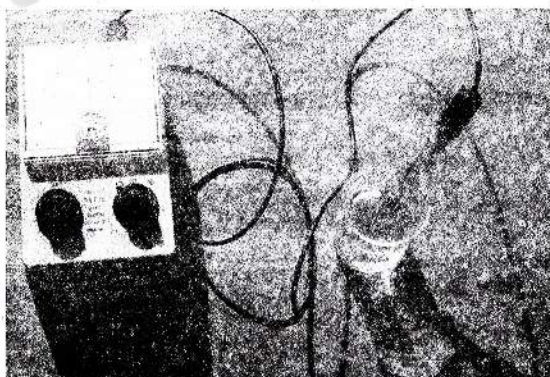


Fig: Colours of universal indicator

(ii) The pH Meter

The pH of a solution can be measured with a pH meter. It consists of a pH electrode connected to a meter. The electrode is dipped into the solution and the meter shows the pH either on a scale or digitally. It is much more reliable and accurate method of measuring pH than Universal Indicator paper, though the latter is often more convenient.

Figure



pH meter

Q.13 What are salts? Write down the characteristic properties of salts.

Ans: Salts are ionic compounds generally formed by the neutralization of an acid with a base.

Acidic and Basic radicals

Salts are made up of positive ions (cations) and negative ions (anions). A cation is metallic and derived from a base, therefore, it is called basic radical. While anion is derived from acids therefore it is called acid radical.

Salt Names

A salt gets its name from the names of the metal and the acid as shown in table

Metal	Acid	Salt Name
Sodium (Na)	Hydrochloric acid (HCl)	Sodium chloride (NaCl)
Potassium (K)	Nitric acid (HNO ₃)	Potassium nitrate (KNO ₃)
Zinc (Zn)	Sulphuric acid (H ₂ SO ₄)	Zinc sulphate (ZnSO ₄)
Calcium (Ca)	Phosphoric acid (H ₃ PO ₄)	Calcium phosphate Ca ₃ (PO ₄) ₂
Silver (Ag)	Acetic acid (CH ₃ COOH)	Silver acetate (CH ₃ COO Ag)

Characteristic properties of salts:

- Salts are ionic compounds found in crystalline form.
- They have high melting and boiling points.
- Most of the salts contain water of crystallization which is responsible for the shape of the crystals. Number of molecules of water are specific for each salt and they are written with the chemical formula of a salt. For example,
Copper sulphate CuSO₄.5H₂O ; Calcium sulphate CaSO₄.2H₂O
- Salts are neutral compounds. Although, they do not compose of equal number of positive and negative ions, but have equal number of positive and negative charges.

Q.14 Explain with examples that how soluble salts are prepared?

Ans: Salts may be water soluble or insoluble. The methods used for the preparation of salts are based on their solubility in water.

General Methods for the preparation of Salts

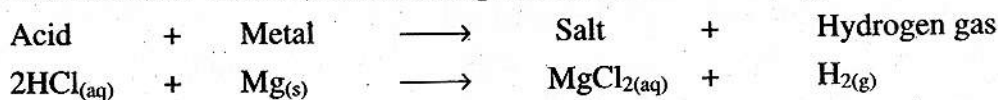
There are five general methods for the preparation of salts. Four methods, make soluble salts but one prepares insoluble salts.

(i) Preparation of soluble salts

Soluble salts are often prepared in water. Therefore, they are recovered by evaporation or crystallization.

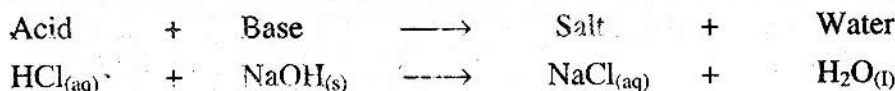
(a) By the reaction of an acid and a metal: (direct displacement method)

This is direct displacement method in which hydrogen ion of acid is replaced by a reactive metal. Such as, calcium, magnesium, zinc and iron, e.g,



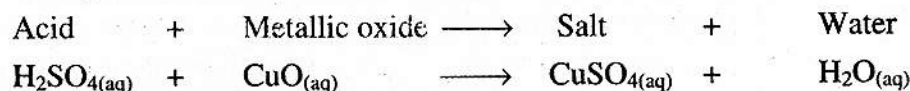
(b) By the reaction of an acid and a base: (Neutralization method)

It is a neutralization reaction in which acid and base react to produce a salt and water.



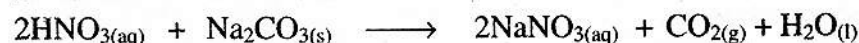
(c) By the reaction of an acid and metallic oxide:

Mostly the insoluble metallic oxides react with dilute acids to form salt and water.



(d) By the reaction of an acid and carbonate:

Dilute acids react with metallic carbonates to produce salts, water and carbon dioxide gas.



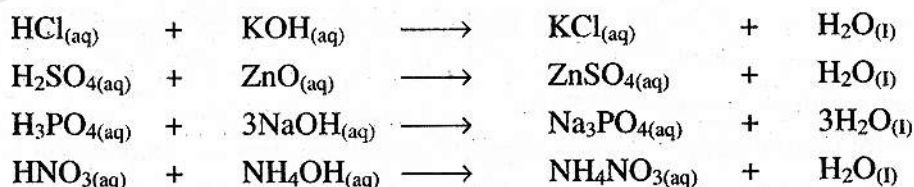
Q.15 Write note on types of salts.

Ans: Following are the main classes of salts

- (i) Normal salts (ii) Acidic salts
- (iv) Basic salts (v) Double salts
- (v) Mixed salts (vi) Complex salts

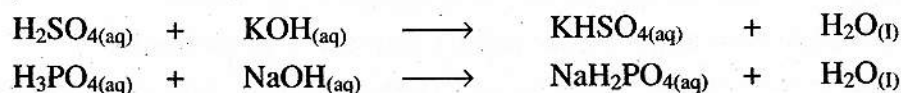
(i) Normal or Neutral salts:

A salt formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH_4^+ ion is called normal or neutral salt. These salts are neutral to litmus, that is,



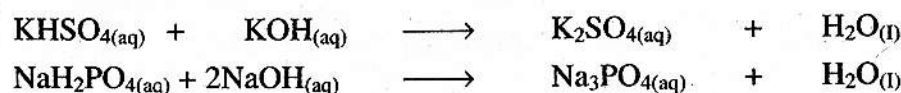
(ii) Acidic Salts

These salts are formed by partial replacement of a replaceable H^+ ions of an acid by a positive metal ion.



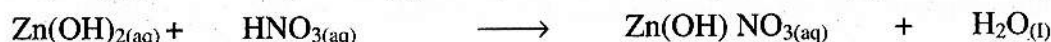
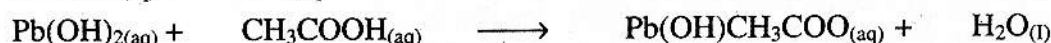
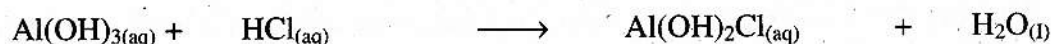
These salts turn blue litmus red.

Acidic salts react with bases to form normal salts.

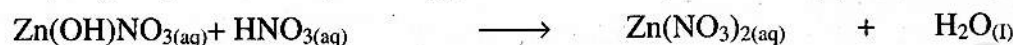
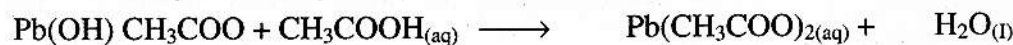
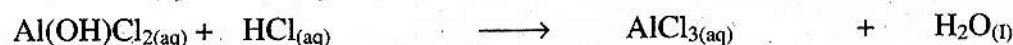


(iii) Basic Salts

Basic salts are formed by the incomplete neutralization of a polyhydroxy base by an acid



These salts further react with acids to form normal salts.

**(iv) Double Salts**

Double salts are formed by two normal salts when they are crystallized from a mixture of equimolar saturated solutions. The individual salt components retain their properties. The anions and cations give their respective tests. Mohr's salt $\text{FeSO}_4 \cdot (\text{NH}_4)_2 \text{SO}_4 \cdot 6\text{H}_2\text{O}$; Potash Alum $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$; Ferric alum $\text{K}_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$, are examples of double salts.

(v) Mixed Salts

Mixed salts contain more than one basic or acid radicals. Bleaching powder Ca(OCl)Cl , is an example of mixed salts.

(vi) Complex Salts

Complex salts on dissociation form a simple cation and a complex anion or vice versa. Only the simple ion yields the characteristics test for cation or anion. Examples are as follow:

Potassium ferrocyanide $\text{K}_4 [\text{Fe(CN)}_6]$ gives on ionization, a simple cation K^+ and complex anion $[\text{Fe(CN)}_6]^{-4}$

Q.16 Write down uses of salts.

Ans. Salts have vast applications in industries and in our daily life. Some common salts and their uses are given in Table

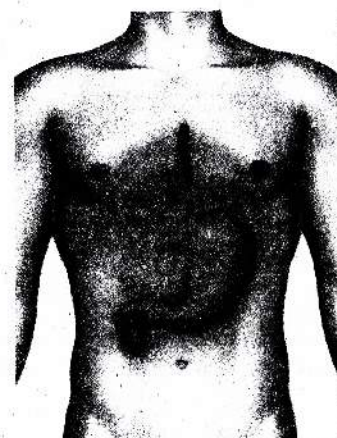
Name of salts	Common and industrial Uses
Sodium Chloride (NaCl)	It is commonly used as a table salt and for cooking purposes. It is also used for de-icing roads in winter and for the manufacture of sodium metal, caustic soda, washing soda.

Sodium carbonate (Na_2CO_3) soda ash	It is used for the manufacture of glass, detergents, pulp and paper and other chemicals.
Sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) Washing soda	It is used as cleaning agent for domestic and commercial purposes, for softening of water, in manufacture of chemicals like caustic soda (NaOH), borax, glass, soap and paper.
Sodium sulphate (Na_2SO_4)	It is used for the manufacture of glass, paper and detergents.
Sodium silicate (Na_2SiO_3)	It is used for the manufacture of detergents, cleaning agents and adhesives.
Sodium chlorate (Na_2ClO_3)	It is used for manufacture of explosives, plastics and other chemicals.
Sodium tetraborate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$)	It is used for manufacture of heat resistance glass (pyrex), glazes and enamels, in leather industry for soaking and cleaning hides.
Calcium Chloride (CaCl_2)	It is used for de-icing roads in winter, as a drying agent of chemical reagents and as a freezing agent.
Calcium oxide (CaO) quick lime	It is used as drying agent for gases and alcohol and in steel making, water treatment and other chemicals like slaked lime, bleaching powder, calcium carbide. For purification of sugar, a mixture of CaO and NaOH called soda lime is used to remove carbon dioxide and water vapours from atmosphere.
Calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)	Gypsum is used as fertilizer, to prepare plaster of paris which is used for making statues, casts etc.
Potassium Nitrate (KNO_3)	It is used as fertilizer and for the manufacture of flint glass.

Q.17 Explain the Stomach acidity.

Ans. Stomach secretes chemicals in a regular way to digest food. These chemicals mainly consist of hydrochloric acids along with other salts. Although hydrochloric acid is highly corrosive, but stomach is protected from its effects because it is lined with cells that produce a base. The base neutralizes stomach acid. The important function of this acid is to break down chemical bonds of foods in the digestion process. Thus, big molecules of food are converted into small ones. It also kills the harmful bacteria of certain foods and drinks.

However, sometimes stomach produces too much acid. It



causes stomach acidity also called **hyperacidity**. **Symptoms** of this disease are feeling burning sensation throughout the gastro intestinal track. These feelings sometimes extend towards the chest, that is called **heart burning**.

Prevention from Hyperacidity

- (i) Avoiding over-eating and staying away from fatty acids and spicy foods.
- (ii) Simple and regular eating, remaining in an upright position for about 45 minutes after taking a meal.
- (iii) Keeping the head elevated while sleeping.

Q.18 Explain the Process of Etching in Art and Industry.

Ans. The process of etching on glass is carried out by using a wax stencil. Stencil is placed on areas of glass or mirror that are to be saved from acid. The glass or mirror is dipped into hydrofluoric acid. The acid dissolves the exposed part of the glass thus etching it. This process has been very dangerous because the acid would damage the skin and tissue of artist's body. Although it is dangerous to deal with acid, yet etching done with acid is very attractive as compared to using other chemicals.



Q.19 Describe Preservatives in food.

Ans. Chemicals used to prevent food spoilage are called preservatives. Food spoiling may be due to microbial actions or chemical reactions. So preservatives serve as either anti-microbial or anti-oxidants or both.

Manufactures add preservatives mostly to prevent spoiling during transportation and storage of foods for a period of time.

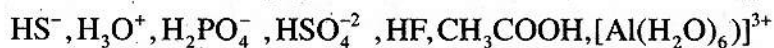
Natural food preservatives are salts, sugar, alcohol, vinegar, etc. they efficiently control the growth of bacteria in food. They are used to preserve meat, fish, etc.



Solved Book Examples

10.1

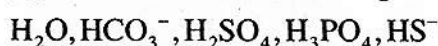
(i) What are conjugate bases of each of the following?



(ii) Give the conjugate acids of the following:



(ii) Which of the following behave both as Bronsted acids and Bronsted bases?



Solution

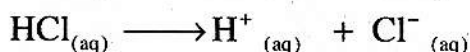
(a)	Conjugate bases	(b)	Conjugate acids
HS^-	: S^{2-}	OH^-	: H_2O
H_3O^+	: H_2O	HCO_3^-	: H_2CO_3
H_2PO_4^-	: HPO_4^{2-}	HPO_4^{2-}	: H_2PO_4^-
HSO_4^-	: SO_4^{2-}	CH_3NH_2	: CH_3NH_3^+
HF	: F^-	CO_3^{2-}	: HCO_3^-
CH_3COOH	: CH_3COO^-		
$[\text{Al}(\text{H}_2\text{O})_6]^{3+}$: $[\text{Al}(\text{H}_2\text{O})_5\text{OH}]^{2+}$	CH_3COOH	: $\text{CH}_3\text{COOH}_2^+$

(c) Bronsted acids, as well as, bases are: H_2O , HCO_3^- , HS^-

10.2. A solution of hydrochloric acid is 0.02M. What is its pH value?

Solution

Hydrochloric acid is a strong acid so it ionized completely. That is



So, its solution also contains 0.02M H^+ ions, i.e., 10^{-2}M .

$$\text{pH} = -\log[\text{H}^+]$$

By putting the values of H^+ ions in the above equation:

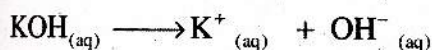
$$\text{pH} = -\log 10^{-2}$$

$$\text{pH} = 2$$

10.3. Find out the pH and pOH of 0.001M solution of KOH?

Solution

Potassium hydroxide solution is a strong base. It ionizes completely such that one mole of KOH gives one mole of OH^- ions.



Therefore, 0.001M solution of KOH produces 0.001M OH⁻ ions.

$$[\text{OH}^-] = 0.001\text{M} \quad \text{or } 10^{-3}\text{M}$$

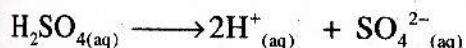
$$\text{pOH} = -\log 10^{-3} = 3$$

$$\text{pH} = 14 - 3 = 11$$

10.4. Find the pH of 0.001M sulphuric acid:

Solution

Sulphuric acid is a strong dibasic acid. It ionizes completely and its one mole produces 2 moles of hydrogen ions as presented in equation.



Therefore, 0.01M sulphuric acid will produce 2×0.01M hydrogen ions. Hence, hydrogen ions concentration is

$$[\text{H}^+] = 2 \times 10^{-2}\text{M}$$

$$\text{pH} = -\log(2 \times 10^{-2}) = -(\log 2 + \log 10^{-2})$$

$$\text{pH} = -\log 2 - \log 10^{-2} \quad \text{as} \quad -\log 10^{-2} = 2$$

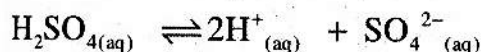
$$\text{pH} = 2 - \log 2 \quad \text{pH} = 2 - 0.3 = 1.7$$

Numericals

1. Calculate the pH and pOH of 0.2M H₂SO₄?

Solution

Ionization of H₂SO₄ in aqueous solution is as



Therefore, 0.2M sulphuric acid will produce 2×0.2M hydrogen ions

Hence Hydrogen ions conc. is

$$[\text{H}^+] = 2 \times 2 \times 10^{-1}\text{M}$$

$$\text{pH} = -\log(4 \times 10^{-1})$$

$$\text{pH} = -(\log 4 + \log 10^{-1})$$

$$\text{pH} = -\log 4 - \log 10^{-1}$$

$$\text{pH} = -0.6 + 1$$

$$\text{pH} = 0.4$$

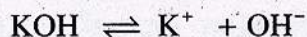
$$\text{pOH} = 14 - 0.4$$

$$= 13.6$$

2. Calculate the pH of 0.1M KOH?

Solution

Ionization of KOH in aqueous solution is as



Therefore, 0.1M KOH produces 0.1M OH^- ions.

$$[\text{OH}^-] = 0.1\text{M} \text{ or } 1 \times 10^{-1} \text{ M}$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pOH} = -\log[10^{-1}]$$

$$\text{pOH} = -\log 10^{-1}$$

$$\text{pOH} = 1$$

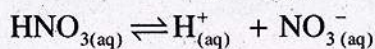
$$\text{pH} = 14 - 1$$

$$\text{pH} = 13$$

3. Calculate the pOH of 0.004M HNO_3 .

Solution

Ionization of HNO_3 in aqueous solution is as



Therefore, 0.004M HNO_3 will produce 0.004M H^+ ions

$$[\text{H}^+] = 0.004\text{M} \text{ or } 4 \times 10^{-3} \text{ M}$$

$$\text{pH} = -\log[4 \times 10^{-3}]$$

$$\text{pH} = -(\log 4 + \log 10^{-3})$$

$$\text{pH} = -\log 4 - \log 10^{-3}$$

$$\text{pH} = -0.602 + 3$$

$$\text{pH} = 3 - 0.602$$

$$\text{pH} = 2.4$$

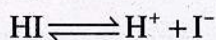
$$\text{pOH} = 14 - 2.4$$

$$\text{pOH} = 11.6$$

4. Complete the following table

Solution

(i) 0.15 M HI



0.15 M hydrogen iodide (HI) releases H^+ ions as

$$[\text{H}^+] = 1 \times 0.15 \text{ M} \text{ or}$$

$$\boxed{[\text{H}^+] = 15 \times 10^{-2} \text{ M}}$$

$$\text{pH} = -\log (15 \times 10^{-2})$$

$$\boxed{\text{pH} = 0.82}$$

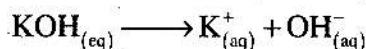
$$\text{pOH} + \text{pH} = 14$$

$$\text{pOH} = 14 - 0.82$$

$$\boxed{\text{pOH} = 13.12}$$

(ii) 0.040 M KOH

KOH is a strong base. It ionized completely. One mole of KOH produce one OH^- ion as shown in balanced chemical equation.



Therefore concentration of OH^- ions is as

$$[\text{OH}^-] = 1 \times 0.040\text{M}$$

$$[\text{OH}^-] = 4.0 \times 10^{-2}\text{M}$$

$$\text{pOH} = -\log (4.0 \times 10^{-2})$$

$$\boxed{\text{pOH} = 1.40}$$

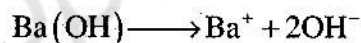
$$\text{pOH} + \text{pH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 1.40$$

$$\boxed{\text{pH} = 12.60}$$

(iii) 0.020 M $\text{Ba}(\text{OH})_2$



$\text{Ba}(\text{OH})_2$ releases two OH^- ions as shown in equation. Therefore concentration of OH^- ions is as

$$[\text{OH}^-] = 2 \times 0.020\text{M}$$

$$\boxed{[\text{OH}^-] = 4 \times 10^{-2}\text{M}}$$

$$\text{pOH} = -\log (\text{OH}^-)$$

$$\text{pOH} = -\log (4 \times 10^{-2})$$

$$\boxed{\text{pOH} = 1.40}$$

$$\text{pH} + \text{pOH} = 14$$

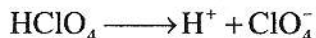
$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 1.40$$

$$\boxed{\text{pH} = 12.6}$$

(iv) 0.00030 M HClO₄

HClO₄ release one H⁺ ion as



Therefore concentration H⁺ ions in the solution will be as

$$[\text{H}^+] = 1 \times 3.0 \times 10^{-4} \text{ M}$$

$$[\text{M}^+] = 3.0 \times 10^{-4} \text{ M}$$

$$\text{pH} = -\log[\text{H}^+]$$

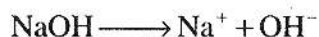
$$\text{pH} = -\log [3.0 \times 10^{-4}]$$

$$\text{pH} = 3.52$$

$$\text{pOH} = 14 - 3.52$$

$$= 10.48$$

(v) 0.55 M NaOH



NaOH releases one OH⁻ ion as

$$[\text{OH}^-] = 55.0 \times 10^{-2} \text{ M}$$

$$\text{pOH} = -\log [\text{OH}^-]$$

$$\text{pOH} = -\log (55 \times 10^{-2})$$

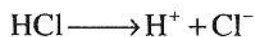
$$\text{pOH} = 0.26$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 13.74$$

(vi) 0.55 M HCl



HCl releases one H⁺ ion as....

$$[\text{H}^+] = 1 \times 0.55 \text{ M}$$

$$[\text{H}^+] = 55 \times 10^{-3} \text{ M}$$

$$\text{pH} = -\log(55 \times 10^{-3})$$

$$\text{pH} = 1.26$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pOH} = 14 - \text{pH}$$

$$= 14 - 1.26$$

$$= 12.74$$

(vii) 0.55 M Ca(OH)₂

Ca(OH)₂ releases two (OH⁻) ions as

$$[\text{OH}^-] = 2 \times 0.055\text{M}$$

$$[\text{OH}^-] = 0.11 \text{ or } 11 \times 10^{-2} \text{ M}$$

$$\text{pOH} = -\log (11 \times 10^{-2})$$

$$\text{pOH} = 0.96$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 0.96$$

$$= 14 - 0.96$$

$$\text{pH} = 13.04$$

Solution	[H ⁺]	[OH ⁻]	pH	pOH
(i) 0.15 M HI	15×10^{-2}	—	0.82	13.12
(ii) 0.040 M KOH	—	4×10^{-2}	12.6	1.4
(iii) 0.020 M Ba(OH) ₂	—	4×10^{-2}	12.6	1.4
(iv) 0.00030 M HClO ₄	3×10^{-4}	—	3.52	10.48
(v) 0.55 M NaOH	—	55×10^{-2}	13.74	0.26
(vi) 0.055 M HCl	55×10^{-3}	—	1.26	12.74
(vii) 0.055 M Ca(OH) ₂	—	11×10^{-2}	13.04	0.96

Short Answer Questions

Q.1 What is meant by Acid?

Ans. The acid is derived from the Latin word “Acidus” meaning sour. Acid is a substance which has sour taste and turns blue litmus red.

Q.2 Write down characteristic properties of Acids and bases

Ans. Properties of acids and bases

Acids	Bases
1) Acids have sour taste for example unripe citrus fruits or lemon Juice.	1) Bases have bitter taste and feel slippery for example soap is slippery to touch.
2) They turn blue litmus red.	2) They turn red litmus blue.

3) They are corrosive in concentrated form.	3) They are non corrosive except concentrated forms of NaOH and KOH.
4) Their aqueous solutions conduct electric current.	4) Their aqueous solutions conduct electric current.

Q.3 Define Arrhenius acid. Give example?

Ans. According to Arrhenius concept acid is a substance which dissociates in aqueous solution to give hydrogen ions. For example HCl is an acid because it ionizes in aqueous solution to provide H^+ ions.

Q.4 Define Arrhenius base. Give example.

Ans. According to Arrhenius concept base is a substance which dissociates in aqueous solution to give hydroxide ions. For example the substance NaOH is a base because it ionizes in aqueous solution to provide OH^- ions.

Q.5 Define Bronsted and Lowry acid.

Ans. An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance. e.g HCl and CH_3COOH

Q.6 Define Bronsted Lowry base.

Ans. A base is a substance that can accept a proton (H^+) from another substance. e.g H_2O and NH_3 .

Q.7 Define conjugate acid and base.

Ans. Conjugate acid

A conjugate acid is a specie formed by accepting a proton by a base. e.g., H_3O^+

Conjugate base

A conjugate base is a specie formed by donating a proton by an acid. e.g., Cl^-

Q.8 Define amphoteric.

Ans. A substance that can behave as an acid as well as a base is called amphoteric. For example water is an amphoteric compound.

Q.9 Write down limitations of Bronsted Lowry concept.

Ans. It has been observed that there are certain substances which behave as acids though they do not have the ability to donate a proton e.g SO_3 . Similarly CaO behaves as a base but

it cannot accept a proton. These observations prove the limitations of Bronsted Lowry concept of acids and bases.

Q.10 Define Lewis-base. Give example.

Ans. A base is substance (molecule or ion) which can donate a pair of electrons. e.g NH_3 .

Q.11 Define Lewis acids. Give example.

Ans. An acid is a substance (molecule or ion) which can accept a pair of electrons. e.g AlCl_3 and BF_3 .

Q.12 Define Adduct.

Ans. The product of any Lewis acid-base reaction is a single specie called an adduct

Q.13 Write down the names of three mineral acids.

Ans. Following acids are called mineral acids. Hydrochloric acid (HCl)
Sulphuric acid (H_2SO_4) and nitric acid (HNO_3).

Q.14 Write down uses of sulphuric acid.

Ans. It is used to manufacture fertilizers, ammonium sulphate, calcium super phosphate, explosives, paints, dyes and drugs. It is also used as an electrolyte in lead storage batteries.

Q.15 Write down uses of nitric acid.

Ans. It is used in manufacturing of fertilizer (ammonium nitrate), explosives, paints, drugs and etching designs on copper plates.

Q.16 Write down uses of hydrochloric acid.

Ans. It is used for cleaning metals, tanning and in printing industries.

Q.17 Write down uses of benzoic acid.

Ans. It is used for food preservation

Q.18 Write down uses of sodium hydroxide.

Ans. It is used for manufacturing of soap, artificial silk, as laboratory reagent in textile and paper industries.

Q.19 Write down uses of calcium hydroxide.

Ans. It is used for manufacturing of bleaching powder, softening of hard water and neutralizing acidic soil and lakes due to acid rain.

Q.20 Write down uses of potassium hydroxide.

Ans. It is used in alkaline batteries.

Q.21 Write down uses of magnesium hydroxide.

Ans. It is used as a base to neutralize acidity in the stomach. It is also used for treatment of bee stings.

Q.22 Write down uses of Aluminium hydroxide.

Ans. It is used as a foaming agent in fire extinguishers.

Q.23 Write down uses of ammonium hydroxide.

Ans. It is used to remove grease stains from clothes.

Q.24 Define pH. Write down its formula.

Ans. pH is the negative logarithm of molar concentration of the hydrogen ions

$$\text{pH} = -\log [\text{H}^+]$$

Q.25 Write down uses of pH.

Ans. i) It is used to determine the acidic or basic nature of a solution.

ii) It is used to produce medicines, culture at a microbiological particular concentration of H^+ ion.

iii) It is used to prepare solutions of required concentrations necessary for certain biological reactions.

Q.26 What are indicators. Give example?

Ans. Indicators are the organic compounds. They have different colours in acidic and alkaline solutions. Litmus is a common indicator. It is red in acid and blue in alkaline solutions.

Q.27 What are universal indicators?

Ans. Some indicators are used as mixtures. The mixture indicators give different colours at different pH values. Hence it is used to measure the pH of a solution. Such a mixed indicator is called a universal indicator.

Q.28 Who are analytical chemists?

Ans. Analytical chemists examine substances qualitatively and quantitatively. They identify substances and evaluate their properties.

Q.29 Define salts.

Ans. Salts are inorganic compounds generally formed by neutralization of an acid with a base. e.g., sodium chloride (NaCl)

Q.30 What is acid and basic radical?

Ans. Salts are made up of positive ions (cations) and negative ions (Anions). A cation is metallic and derived from a base therefore it is called **basic radical**. While anion is derived from acids therefore it is called **acid radical**.

Q.31 Write down any two characteristics of salts.

Ans. salts are ionic compounds found in crystalline form. They have high melting and boiling points.

Q.32 Define normal or neutral salts.

Ans. A salt formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt. e.g NaCl

Q.33 Define Acidic salt.

Ans. These salts are formed by partial replacement of H^+ ions of an acid by a positive metal ion. e.g $KHSO_4$

Q.34 Define basic salt.

Ans. Basic salts are formed by the incomplete neutralization of a polyhydroxy base by an acid. e.g $Al(OH)_3 Cl$

Q.35 Define double salt. Give example.

Ans. Double salts are formed by two normal salts when they are crystallized from a mixture of equimolar saturated solutions. The individual salt components retain their properties. For example Mohr's salt $FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$.

Q.36 Define Mixed salt. Give example.

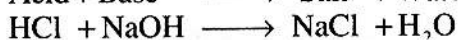
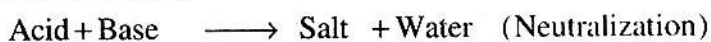
Ans. Mixed salts contain more than one basic or acid radicals. Bleaching powder $Ca(OCl)Cl$, is an example of mixed salts.

Q.37 Define Complex salt. Give example?

Ans. Complex salt on dissociation provides a simple cation and a complex anion or vice versa. Only simple ions yields the characteristics test for cation or anion. E.g., potassium ferrocyanide $K_4 [Fe(CN)_6]^-$

Q.38 Define neutralization reaction. Give example

Ans. A reaction between an acid and a base is called a neutralization reaction: It produces a salt and water.



Q.39 Name three common household substances having

a) pH values greater than 7

- 1) Soap
- 2) Detergent
- 3) Shampoo

b) pH values less than 7

- 1) vinegar
- 2) Citrus fruits
- 3) Butter

c) pH values equal to 7

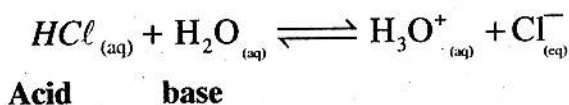
- 1) Water
- 2) NaCl
- 3) Sugar

Q.40 Define a base and explain all alkalis are bases, but all bases are not alkalis.

Ans. A base is a substance which turn red litmus to blue and having pH value greater than 7. Water soluble base is called alkali but some bases are not soluble in water, so all alkalis are bases but all bases are not alkalis.

Q.41 Define Bronsted-Lowery base and explain with an example that water is Bronsted-lowery base.

Ans. Bronsted-Lowery base is a substance(molecule or ion) which can accept a proton (H^+) from another substance. For example, when HCl dissolves in water, HCl acts, as an acid and H_2O act as a base because it accepts a proton.



Q.42 How can you justify that Bronsted –Lowry concept of acid and base is applicable to non aqueous solutions?

Ans. According to Bronsted-Lowry concept:

“An acid is a compound which donates a proton (H^+).”

“A base is a compound which accepts a proton (H^+).”

So, the compounds which have H^+ ions also act as acids in addition to water e.g., CH_3COOH while the compounds which have not OH^- ions also act as base e.g., NH_3 .

Q.43 Which kind a bond forms between Lewis acid and base?

Ans. Coordinate covalent bond forms between Lewis acid and base.

Q.44 Why H^+ ion acts as a Lewis acid?

Ans. Because it has an empty orbital that can accommodate a pair of electrons.

Q.45 Name two acids used in the manufacture of fertilizers.

Ans. Sulphuric acid and nitric acid both are used in the manufacture of fertilizers.

Q.46 Define pH. What is the pH of pure water?

Ans. pH is the negative logarithm of molar concentration of the hydrogen ions. that is,
 $pH = -\log [H^+]$. The pH value of pure water is 7.

Q.47 How many times a solution of pH 1 will be stronger than that of a solution having pH 2?

Ans. Because the pH scale is logarithmic, a solution of pH 1 has 10 times higher concentration of $[H^+]$ than that of a solution of pH2.

Q.48 Na_2SO_4 is a neutral salt while $NaHSO_4$ is an acidic salt justify.

Ans. Because in Na_2SO_4 there is total replacement of ionizable H^+ ions. While in $NaHSO_4$ the partial replacement of a replaceable H^+ ions of an acid takes place by a positive metal ion. It turns red litmus to blue.

Q.49 Give few characteristics of salts.

Ans. There are following characteristics of salt.

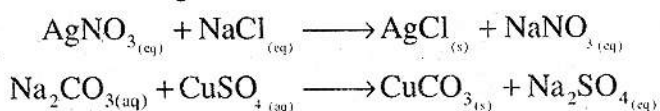
- 1) Salts are ionic compounds found in crystalline form.
- 2) They have high melting and boiling point.

Q.50 How the soluble salts are recovered from water?

Ans. Soluble salts are recovered by evaporation or crystallization.

Q.51 How the insoluble salts are prepared?

Ans. In this method, usually solutions of soluble salts are mixed. During the reaction exchange of ionic radicals (i.e. metallic radicals exchange with acidic radicals) takes place to produce two new salts. One of the salt is insoluble and other is soluble. The insoluble salt precipitates (solidify in solution) e.g.,



Q.52 Why a salt is neutral, explain with an example?

Ans. A salt is formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt. These salts are neutral to litmus,



Q.53 Name an acid used in the preservation of food.

Ans. Benzoic acid is used for food preservation.

Q.54 Name the acids present in.

Ans.

- 1) **Vinegar:**
Acetic acid
- 2) **Ant sting**
Formic acid
- 3) **Citrus fruit**
Citric acid
- 4) **Sour milk**
Lactic acid

Q.55 How can you justify that Pb(OH)NO_3 is a basic salt?

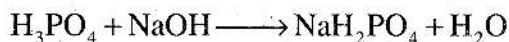
Ans. Pb(OH)NO_3 is a basic salt because it is formed by the incomplete neutralization of a poly hydroxyl base by an acid.



It can react with acids to form normal salts. $\text{Pb(OH)NO}_3 + \text{HNO}_3 \longrightarrow \text{Pb(NO}_3)_2 + \text{H}_2\text{O}$

Q.56 You are in a need of an acidic salt. How can you prepare it?

Ans. An acidic salt is formed by the partial replacement of a replaceable H^+ ions of an acid by a positive metal ion.



Q.57 Which salt is used to prepare plaster of paris?

Ans. Calcium sulphate($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is used to prepare plaster of Paris.

Q.58 What is the difference between Arrhenius base and Bronsted-lowry base?

Ans. Difference between Arrhenius base and Bronsted-Lowry base

Arrhenius base:

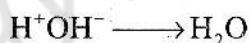
A base is a substance which dissociates in aqueous solution to give hydroxide ion. (OH^-) e.g., NaOH

Bronsted-Lowry base:

Bronsted-Lowry base is a substance which can accept a proton (H^+) from another substance e.g., NH_3

Q.59 What do you mean by neutralization reaction according to Arrhenius acid base concept?

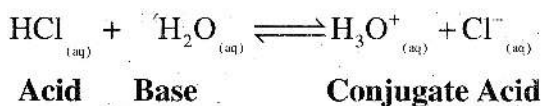
Ans. A neutralization reaction according to Arrhenius concept acid gives H^+ ions and bases gives OH^- ions.



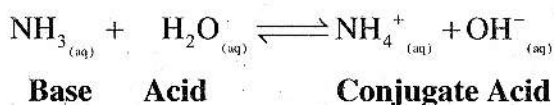
Q.60 Prove that water is an amphoteric specie.

Ans. Water is an amphoteric specie because it acts as acid as well as base.

As a base:



As a acid:



Q.61 How can you justify that NH_3 is Bronsted-Lowry base but not Arrhenius base?

Ans. Ammonia(NH_3) is Bronsted-Lowry base because it has the ability to accept a proton(H^+)but not Arrhenius base because it does not produce hydroxide ion (OH^-)in aqueous solution.

Q.62 State and explain the neutralization reaction according to Lewis concept.

Ans. A neutralization reaction according to Lewis concept is donation and acceptance of an electron pair to form a coordinate covalent bond in an adduct.

Q.63 Define and Give the characteristics of Lewis acid.

Ans. There are following characteristics of Lewis acids.

- Lewis acids, are molecules, in which the central atom has incomplete octet e.g. BF_3 , AlCl_3
- Simple cations can act as Lewis acids. since they are deficient in electrons e.g. Na^+ , Ca^{2+}

Q.64 Why BF_3 behaves as a Lewis acid?

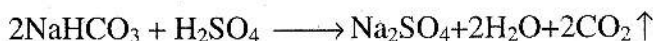
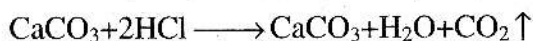
Ans. BF_3 acts as Lewis acid because it accepts a pair of electrons, the central atom has only six electrons around it, therefore, it accepts an electron pair.

Q.65 Water is an amphoteric species= according to Bronsted-Lowry concept. What is the nature of water according to Lewis concept?

Ans. According to Lewis concept water acts as Lewis base because it has the ability to donate electron pair.

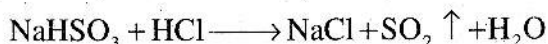
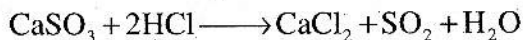
Q.66 When acid reacts with carbonates and bicarbonates, which gas evolves out?

Ans. When acid reacts with carbonates and bicarbonates carbon dioxide(CO_2) gas evolves it.



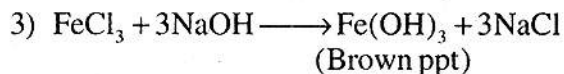
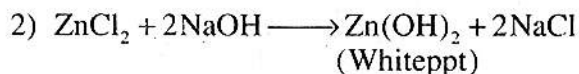
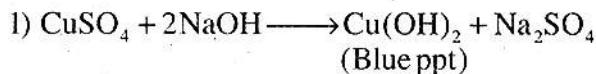
Q.67 Which type of salts produce SO_2 gas on reacting with acids?

Ans. Acids react with sulphites and bisulphate to form salts with liberation of sulphur dioxide (SO_2) gas.



Q.68 Write down colours of the precipitates formed by reaction of aqueous caustic soda with solutions of copper, zinc and ferric salts.

Ans.



Q.69 Why pure water is not a strong electrolytes?

Ans. Because water has smaller value of degree of ionization due to presence of strong forces i-e Hydrogen bonding.

Q.70 HCl and H₂SO₄ are strong acids while their solutions are equimolar, they have different PH values. Why they have different PH values?

Ans. Because H₂SO₄ is a dibasic acid. It produces two hydrogen ions while HCl is monobasic acid it produces only one hydrogen ion. That is why both acids have different pH values with their equimolar solutions.

Q.71 Difference between 'P' and Ph value.

Ans.

P

'P' scale is the conversion of very small figures into positive figure by taking the common logarithm of the small figure and multiplying it with -1

pH

pH is the negative logarithm of molar concentration of the hydrogen ions, that is
 $\text{PH} = -\log[\text{H}^+]$

Q.72 How the salts are named?

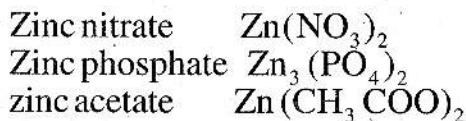
Ans. A salt gets its name from the names of the metal and the acid e.g

Metal	Acid	Salt Name
Sodium(Na)	Hydrochloric Acid (HCl)	Sodium Chloride (NaCl)

Q.73 Name the salts which are formed when Zn metal reacts with following acids.

- Nitric Acid
- Phosphoric Acid
- Acetic Acid

Ans.



Q.74 Name the type of reaction that takes place between an acid and a metal. Which gas would evolve in the reaction? Explain with an example.

Ans. When acid reacts with metal, salt and hydrogen gas are produced. This type of reaction is called direct displacement method.

Acid Metal Salt Hydrogen gas



Q.75 Names the types of salts.

Ans. There are following types of salts.

- | | |
|------------------|-------------------|
| i. Normal Salts | iv. Double Salts |
| ii. Acidic Salts | v. Mixed Salts |
| iii. Basic Salts | vi. Complex Salts |

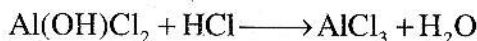
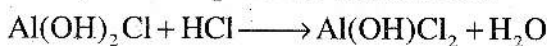
Q.76 H_3PO_4 is weak acid but its salt(Na_3PO_4)with strong base NaOH is neutral. Explain it.

Ans. It is normal or neutral salt which is formed by the total replacement of ionization of H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt.



Q.77 How the basic salts turns into normal salts. Explain with an example.

Ans. When basic salts react with acids it produces normal salts.



Normal Salt

Q.78 Define acid rain

Ans. Acid rain is formed by dissolving acidic air pollutants like oxides of sulphur and nitrogen by rain water. As a result pH of the rain it damages animals, Plants, buildings, water bodies and even soil.

Multiple Choice Questions

1. A base is a substance which neutralizes an acid. Which of these substances is not a base?

- (a) aqueous ammonia
- (b) sodium chloride
- (c) sodium carbonate
- (d) calcium oxide

2. Lewis acid-base concept have the following characteristics except:

- (a) formation of an adduct
- (b) formation of a co-ordinate covalent bound
- (c) donation and acceptance of an electron pair
- (d) donation and acceptance of a proton

3. Acetic acid is a weak acid because it

- (a) is used in cooking and flavouring food
- (b) has very low pH
- (c) is not fully ionized
- (d) does not contain any hydrogen ions

4. A salt is not composed of

- (a) a metallic cation
- (b) non-metallic anion
- (c) an anion of a base
- (d) an anion of an acid

5. If a liquid has a pH of 7 then it must

- (a) be a colourless and odourless liquid
- (b) freeze at 0°C and boil at 100°C
- (c) be natural
- (d) be a solution containing water

6. A salt always

- (a) contain ions
- (b) contains water of crystallization

- (c) dissolves in water
- (d) forms crystals which conduct electricity.

7. Dilute acids react with carbonates to produce the given products except

- a) salt b) water
- c) carbon dioxide d) hydrogen

8. In the preparation of insoluble salts, which one of the facts is incorrect?

- (a) two soluble salts are mixed
- (b) two insoluble salts are mixed
- (c) one of the salt produced is insoluble
- (d) both of the salts produced are insoluble

9. A reaction between an acid and a base produces.

- (a) salts and water
- (b) salt and gas
- (c) salt and an acid
- (d) salt and a base

10. The conjugate acid of HPO_4^{2-} is

- (a) PO_4^{3-} (b) $\text{H}_2\text{PO}_4^{2-}$
- (c) H_2PO_4^- (d) H_3PO_4

11. What is the POH of a 0.02 M Ca(OH)_2 ?

- (a) 1.698 (b) 1.397
- (c) 12.31 (d) 12.61

12. Which one of the following species is not amphoteric?

- (a) H_2O (c) NH_3

- (c) HCO_3^- (d) SO_4^{2-}

13. The product of Lewis acid-base reaction is called adduct. The bond between the adduct species is

- (a) ionic
(b) covalent
(c) metallic
(d) co-ordinate covalent

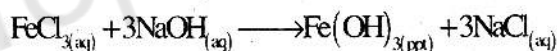
14. The water of crystallization is responsible for the

- (a) melting points of crystals
(b) boiling points of crystals
(c) shapes of crystals
(d) transition point of crystals

15. You want to dry a gas which one of the following salt you will use?

- (a) CaCl_2 (b) NaCl
(c) CaO (d) Na_2SiO_3

16. Ferric hydroxide ($\text{Fe}(\text{OH})_3$) is precipitated out of solution when aqueous sodium hydroxide solution is added to ferric chloride (FeCl_3)



Colour of the precipitate

- (a) white (b) blue
(c) dirty green (d) brown

17. Which ion is the conjugate base of sulphuric acid?

- (a) SO_3^{2-} (b) S^{2-}
(c) HSO_3^- (d) HSO_4^-

18. Which one of the following is a Lewis base?

- (a) NH_3 (b) BF_3
(c) H^+ (d) AlCl_3

19. According to the Lewis concept, acid is a substance which can

- (a) donate a proton
(b) donate a pair of electron
(c) accept a proton
(d) accept a pair of electron

20. Give $K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14}$ at 25°C what is the concentration of H^+ in pure water at 25°C ?

- (a) $1 \times 10^{-7} \text{ mol dm}^{-3}$
(b) $1 \times 10^7 \text{ mol dm}^{-3}$
(c) $1 \times 10^{-14} \text{ mol dm}^{-3}$
(d) $1 \times 10^{14} \text{ mol dm}^{-3}$

21. Jabir Bin Haiyan prepared

- (a) Nitric acid (b) hydrochloric acid
(c) Sulphuric acid (d) All of these

22. Lavoisier named binary compounds of oxygen acids in

- (a) 1787 (b) 1790
(c) 1815 (d) 1828

23. Who proved that the presence of hydrogen as the main constituent of all acids.

- (a) Lavoisier (b) Humphrey Davy
(c) Dalton (d) Arrhenius

24. The word acid is derived from the

- (a) Greek word (b) Latin word
(c) English word (d) Arabic word

25. Acidus means

- (a) Sour (b) Bitter
(c) Sweet (d) salty

26. Which acid is present in our stomach.

- (a) Nitric acid (b) Hydrochloric acid
(c) Sulphuric acid (d) All of these

27. All acids turn blue litmus

- (a) Red (b) Blue
(c) Pink (d) White
28. All bases turn red litmus
(a) Red (b) Blue
(c) Pink (d) White
29. Arrhenius presented his concept about acids and bases in
(a) 1785 (b) 1787
(c) 1923 (d) 1930
30. According to Arrhenius concept acid is a substance which dissociates in aqueous solution to give
(a) Hydrogen ions (b) Hydroxide ions
(c) Both a & b (d) None of these
31. According to Arrhenius concept base is a substance which dissociates in aqueous solution to give
(a) Hydrogen ions (b) Hydroxide ion
(c) Both a & b (d) None of these
32. Which one is not an Arrhenius acid?
(a) HCl (b) H_2SO_4
(c) CO_2 (d) HNO_3
33. Which one is not an Arrhenius base?
(a) NaOH (b) KOH
(c) $\text{Ca}(\text{OH})_2$ (d) NH_3
34. Bronsted and Lowry presented their theories of acids and bases in
(a) 1785 (b) 1787
(c) 1923 (d) 1925
35. According to Bronsted and Lowry concept an acid is a substance that can donate
(a) proton (b) electron pair
(c) neutron (d) electron

36. A conjugate acid is a specie formed by accepting a
(a) proton (b) electron pair
(c) neutron (d) electron
37. According to Bronsted and Lowry concept a base is a substance that can accept
(a) proton (b) electron pair
(c) neutron (d) electron
38. A conjugate base is a specie formed by donating a
(a) proton (b) electron pair
(c) neutron (d) electron
39. A substance which can behave as an acid as well as a base is called
(a) Acid (b) base
(c) amphoteric (d) neutral
40. According to Lewis concept a base is a substance which can donate
(a) Proton (b) electron pair
(c) neutron (d) electron
41. According to Lewis concept an acid is a substance which can accept
(a) proton (b) electron
(c) neutron (d) electron pair
42. The product of any Lewis acid base reaction is a single specie called
(a) salt (b) water
(c) adduct (d) none
43. Which one is Lewis acid?
(a) BF_3 (b) AlCl_3
(c) FeCl_3 (d) All these
44. Which one is Lewis base?
(a) NH_3 (b) R-NH_2
(c) ROH (d) All of these
45. When acids react with metals which gas is evolved?

- (a) H_2 (b) O_2
(c) Cl_2 (d) N_2
46. When acids react with carbonates and bicarbonates which gas is evolved?
(a) H_2 (b) CO_2
(c) Cl_2 (d) N_2
47. When acid reacts with sulphites and bisulphites which gas is evolved?
(a) H_2 (b) CO_2
(c) SO_2 (d) NH_3
48. Which one is mineral acid?
(a) HCl (b) H_2SO_4
(c) HNO_3 (d) All of these
49. Which acid is used an electrolyte in lead storage battery?
(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3COOH
50. Which acid is used for etching designs on copper plates?
(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3COOH
51. Which acid is used for food preservation?
(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3COOH
52. Citric acid is present in
(a) citrus fruits (b) sour milk
(c) Rancid butter (d) apple
53. Formic acid is present in
(a) stings of bees (b) sour milk
(c) apple (d) fats
54. Butyric acid is present in
(a) citrus acid (b) sour milk
(c) rancid butter (d) apple
55. Mallic acid is present in
(a) Apple (b) Feats
(c) String of bees (d) urine
56. Uric acid is present in
(a) apple (b) fats
(c) urine (d) grapes
57. stearic acid present in
(a) apples (b) fats
(c) urine (d) grapes
58. Alkalis react with ammonium salt to liberate
(a) SO_2 (b) CO_2
(c) NH_3 (d) H_2
59. Which is used to manufacture of soap?
(a) $NaOH$ (b) $Ca(OH)_2$
(c) KOH (d) $Mg(OH)_2$
60. Which one is used for alkaline batteries?
(a) $NaOH$ (b) $Ca(OH)_2$
(c) KOH (d) $Mg(OH)_2$
61. Which is used as foaming agent in fire extinguishers?
(a) $NaOH$ (b) KOH
(c) $Al(OH)_3$ (d) NH_4OH
62. Which is used to remove the grease stains from clothes?
(a) $NaOH$ (b) KOH
(c) $Al(OH)_3$ (d) NH_4OH
63. The value of constant of ionic product of water K_w at $25^\circ C$
(a) 1.0×10^{-4} (b) 1.0×10^{14}
(c) 1.0×10^7 (d) 1.0×10^{-7}
64. pH value normally varies from
(a) 0 - 14 (b) 1-14
(c) 7 - 14 (d) 10 - 14
65. pH of neutral solution is always
(a) 6 (b) 5
(c) 7 (d) 10
66. Acidic solutions have pH value

- (a) less than 7 (b) greater than 7
(c) equal to 7 (d) None of these

67. Basic solutions have pH value

- (a) Less than 7 (b) greater than 7
(c) equal to 7 (d) none of these

68. Indicators are the

- (a) Inorganic compounds
(b) organic compounds
(c) Ionic compounds
(d) covalent compounds

69. Phenolphthalein produces red colour in

- (a) Acid (b) base
(c) both a & b (d) None

70. Methyl orange produces which colour in basic solution

- (a) Red (b) Yellow

- (c) Pink (d) white

71. Which salt is used as a table salt?

- (a) NaCl (b) Na_2CO_3
(c) Na_2SiO_3 (d) NaCl

72. Which salt is used for the manufacture of detergents, pulp and paper?

- (a) NaCl (b) Na_2CO_3
(c) Na_2SiO_3 (d) NaCl

73. Which is used for cleaning agent for domestic and commercial purpose?

- (a) NaCl (b) Na_2CO_3
(c) NaHCO_3 (d) Na_2SiO_3

Answer Key

1	b	2	d	3	c	4	c	5	c
6	a	7	d	8	d	9	a	10	c
11	b	12	d	13	d	14	c	15	c
16	d	17	d	18	a	19	d	20	a
21	b	22	a	23	b	24	b	25	a
26	b	27	a	28	b	29	b	30	a
31	b	32	c	33	b	34	c	35	a
36	a	37	a	38	a	39	c	40	b
41	d	42	c	43	d	44	d	45	a
46	b	47	c	48	d	49	a	50	b
51	d	52	a	53	a	54	c	55	a
56	c	57	b	58	c	59	a	60	c
61	c	62	d	63	b	64	a	65	c
66	a	67	b	68	b	69	b	70	b
71	a	72	b	73	d				